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EPIDEMIC

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MALIGNANT CHOLERA.

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EPIDEMIC OR MALIGNANT CHOLERA.

UNTIL 1830, the inhabitants of Europe and of America were in the habit of regarding the stories of terrible epidemics which devastated Europe in the Middle Ages as belonging to the history of a time which had only a remote, and merely intellectual, interest for the present generation. But a pestilence as terrible as any which the annals of our race record was soon to sweep like a deluge of desolation across the world. On the 9th of August, 1817, it began its death-march at Jessora, a city of Hindostan, whence it advanced to Calcutta, Madras, and Bombay. In the following year it reached the Eastern Archipelago, and in the island of Java, alone, decimated the entire population. Thence it spread into China, and in the course of 1820 entered the northern capital, Pekin. About the same time it began its western progress, ravaged Persia and Arabia, and in 1822 extended as far west as Tripoli, on the shores of the Mediterranean Sea. In the following year the disease showed itself on the northern shore of the Caspian Sea, where it subsided, and appeared for a time to have suspended its progress, for until 1829

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we hear no further of its ravages. The pestilence seemed rather to have retired to its original lair upon the banks of the Ganges. But in 1829 it again broke forth upon its old track, eastward and westward, and in the following year we find it raging again around the shores of the Caspian. But this time it did not pause there. It invaded Russia, destroyed more than four thousand persons in Moscow in the space of two months, advanced to St. Petersburg, Warsaw, and the Baltic ports, and appeared in Berlin, Vienna, and Hamburg at the close of 1831. Early in the following year it invaded Great Britain at its northern part, and, while spreading through this and the neighboring island, broke out in Paris on the 26th of March, and spreading throughout France destroyed 120,000 persons in the course of the year. The steady progress of the pestilence westward rendered it probable that it would soon pass the ocean and visit our own shores. Anxiety and dread filled the hearts of the population, and in all directions the municipal authorities prepared to remove the causes which were supposed to favor the development of the disease. It soon became evident that these apprehensions were far from premature. The first case of cholera on the American continent occurred at Quebec, on the 8th of June, 1832, and the disease had reached New York by the 24th of the same month. In the course of a year it destroyed 3500 inhabitants of that city. It was introduced into Quebec by five vessels from Europe, which had together lost 179 passengers by cholera during the voyage.

"All these ships and their passengers were quarantined at Grosse Isle, a few miles below Quebec. On June 7 the St. Lawrence steamer Voyageur conveyed a load of these emigrants and their baggage, some to Quebec, and the majority to Montreal on the 10th.

"The first cases of cholera in America occurred in emigrant boarding-houses in Quebec on the 8th, and the same pest steamboat, the Voyageur, landed persons dead and dying of cholera at Montreal, a distance of two hundred miles, in less than thirty hours; and over this long distance, thickly inhabited on both shores of the St. Lawrence, cholera made a single leap, without infecting a single village or a single house between the two cities, with the following exceptions: A man picked up a mattress thrown from the Voyageur, and he and his wife died of cholera; another man fishing on the St. Lawrence was requested to bury a dead man from the Voyageur, and he, his wife and nephew died. The captain of a passing boat requested an Indian to bury a man from on board; this and five other Indians were attacked and died.

"The town of Three Rivers, half-way between Quebec and Montreal, forbid steamers to land, and escaped for a long time.

"From Montreal the great influx of emigrants was forwarded away, by the Emigrant Society, as fast as they arrived, and by them the pestilence was sown at each stopping-place. Kingston, Toronto, and Niagara soon became affected. In the end over 4000 persons died of cholera in Montreal, and more than an equal number in Quebec."

From the points mentioned the epidemic extended first to Philadelphia, Baltimore, Washington, and the Southern cities generally. In 1833 it broke out in the West Indies, and thence invaded the towns upon the borders of the Gulf of Mexico. In the following year it prevailed in the provinces on our northern borders and in the State of New York, and spread over the whole country during 1835 and 1836. From this period it rapidly subsided, and, although for a year or two cases occurred here and there, the disease had no longer an epidemic character, nor was it of a malignant type. Gradually it disappeared, and the impression became general that we had done with the formidable invader. For nearly ten years this consolatory reflection was entertained; but towards the close of that period the certain though distant signs were visible of its return to our shores.

In 1845 it was known to be advancing on its former path, which it steadily pursued, and entered England in October, 1848, at Sunderland, the very town at which it first appeared in 1831.

"During the second epidemic in Europe, in 1848, two vessels sailed from Havre, where cholera prevailed; one the New York, for New York, and the other the Swanton, for New Orleans. Both contained large numbers of German emigrants. On one the cholera appeared when sixteen days out, with fourteen deaths; on the other in twenty-six days, with thirteen deaths. The New York arrived at Staten Island, December 2, 1848, and a severe epidemic broke out, but was confined to the Quarantine grounds. The Swanton arrived at New Orleans, December 11; no quarantine was instituted, and in two days patients were taken into the Charity Hospital. This was the beginning of a severe epidemic, which increased in power all winter, till in June, 1849, 2500 died of it in New Orleans. December 20, 1848, it reached Memphis, by steamboat from New Orleans, where for twenty-five days it was confined to the landing-place, but then spread. In the spring it was carried to St. Louis and Cincinnati and the whole Mississippi Valley. In October it reached Sacramento, by means of overland emigrants, and almost at the same time by the United States steamer Northerner, from Panama. The Chinese of California suffered most severely."

In the following April (1849) it reappeared in the public stores at the Quarantine station, Staten Island, and in the succeeding month in the city of New York. From New Orleans in the South, and New York in the North, the cholera spread over the continent, and was even more destructive than during its first invasion. In New York City alone the deaths exceeded 5000. Another pause ensued, which was not broken until the spring of 1854. As before, the starting-point of the epidemic was in

Asia. In Teheran, a city of Persia, 11,000 persons perished. It ravaged the South of Europe, destroying an incredible number of victims. At Messina alone upwards of 12,000 are said to have fallen. In France nearly 114,000 were cut off during the year, and in England about 16,000.

Cholera patients arrived at New York in the month of May, 1854, from Europe, and the epidemic straightway commenced. It prevailed during about three months, and destroyed nearly 2000 persons. In Philadelphia during the same period the mortality exceeded 500. I need not trace the further progress of the epidemic, which in this country was less fatal than that of 1849: suffice it to say that it extended to many towns in New England and westward, along the great channels of immigration, through the United States and Canada. Thirteen hundred persons perished at Montreal, and in the small town of Detroit the deaths amounted to 1000.

Once more (December, 1864) the pestilence went abroad. The immediate occasion of its dissemination appears to have been a great Mohammedan festival which was held at Mecca in the spring of that year. Thither several hundred thousand pilgrims flocked from every part of Turkey and Southern Asia, and large numbers among them, even before reaching their destination, died of cholera. There is no doubt that the disease was carried along with the vast crowd which issued from the region where it is endemic,—the great peninsula of Hindostan,—and by them was disseminated in Arabia and Egypt, whence it advanced along the great highways of travel and commerce into Europe. On the 11th of May the first case occurred in Alexandria, and thence it was carried to Ancona, on the eastern shore of Italy. From Alexandria also it was transported to Constantinople, where it began to prevail July 13. By the end of August it had spread to Malta, Tripoli, Barcelona, and Gibraltar. On the 11th of September it broke out at Marseilles, whence it advanced to Paris on the 25th of the same month; while from Gibraltar it was carried to Southampton, where the first cases of the disease occurred September 27. Seventeen days later it began to appear in London. Finally, on November 2 the steamship Atalanta arrived at Quarantine in the Bay of New York, with fifteen passengers sick with cholera. This vessel was crowded with emigrants from Switzerland and Germany, who had reached Havre by the way of Paris, where cholera then prevailed. The disease did not spread at the Quarantine station nor in the city of New York.

In 1867 the cholera again prevailed in this country. Starting from two points, New York and New Orleans, where it had been introduced from Europe, it followed the lines of travel, and could in many instances be distinctly traced to the movements of persons affected with the disease.

This imperfect sketch will give some idea of the progress of epidemic cholera, and of the devastation committed by it, which falls but little short of that produced by the "*plague*," the "*black death*," and other mortal epidemics. Indeed, its ravages far exceed theirs, if the number of places where the cholera prevailed, and the results of its havoc in all countries, be considered. All other epidemics, except influenza, have been comparatively partial and local in their action: this alone has the world for its arena, and takes its victims throughout the whole human family. So mighty a foe it is that you may be obliged to meet. The experience of the past renders it all but certain that some of you will be called to the performance of this duty; and I therefore shall endeavor to prepare you for the fight, by disclosing the nature, the habits, and the vulnerable points of the enemy, that you may be enabled to exclude it from your neighborhood, or conquer it if it should succeed in entering.

CAUSES.—The first question which naturally presents itself in entering on the study of the disease relates to the *causes* which produce it. We should first answer the question, What causes do *not* occasion it? Thus, we may be sure that all possible combinations of natural causes, heat and cold, dryness and moisture and electricity, have existed in Europe and America from the beginning; yet they never developed cholera. Neither did any of the more accidental causes, such as famine, or war, the filth, the crowding, or the misery of the poor, the luxury or the voluptuousness of the rich, or the sensuality of all classes. The essential cause of cholera, like the cause of smallpox or of yellow fever, is specific. Yet we may inquire what circumstances favor the generation of the disease, what influences promote the development and propagation of its specific germs or morbid poison.

HEAT.—A high temperature is undoubtedly one of the most efficient among the causes which favor the dissemination of cholera. Its origin in the hot climate of Hindostan, and its general progress, prove this conclusively. In nearly all of the places where there is a great difference between the summer and the winter temperature, the disease has disappeared during the cold season, and attained its greatest intensity during the hot months of the year. In this country, at least, the rule is, I believe, without exception. Like yellow fever and miasmatic fevers, cholera shrinks and vanishes at the touch of frost.

The only apparent exception to this statement is the fact that cholera has prevailed in several cities of Russia during the winter. But this very exception confirms the rule; for in Russia the intense cold of the winter compels the inhabitants to seal their houses by every possible means, while the atmosphere of their interior is kept at a high temperature by huge stoves which render ventilation unusual, if not impossible.

The state of *moisture* or *dryness* of the atmosphere, its electrical condition, the prevalence of certain winds, etc., have been held to be conditions adapted to develop cholera. But none of these influences, taken in their largest sense, have been proved to exert a positive power in generating the disease. All kinds of weather, except the very cold, have been known to coincide with epidemics of cholera.

At the same time, I should mention that in London, and I believe that other places furnish similar illustrations, the mortality was in direct proportion to the lowness of the soil and its proximity to the river. But, when it is recollected that it is in these low and damp districts that the most squalid poverty and the densest population of the English capital exist, too much influence must not be allowed to the atmospheric cause; but, on the contrary, its full weight should be given to the depressing and deleterious action of want, filth, and vice. Wherever the streets are *dark*, *narrow*, and *filthy*, the houses crowded, and the inhabitants ill fed and ill clothed, the mortality of cholera is at least one-half greater than in districts whose inhabitants are surrounded by the comforts of life. In the United States I suspect that the difference between the two classes is even greater. It must be acknowledged that occasional exceptions to this rule have been observed, but not enough to invalidate it, nor to lessen our obligation to cleanse our houses when threatened by a visit from the pestilence; for most frequently it passes by clean and dry places to revel in filth and reek.

Another cause inseparable, almost, from the conditions which have been considered is intemperance in the use of intoxicating drinks. Wherever cholera has prevailed, its easiest victims have been drunkards; and, as the number of these degraded beings is greatest among the very poor and the vicious, the mortality of such classes of persons by cholera has always been excessive. It is unnecessary to cite illustrations in proof of a fact which is notorious and unquestionable. I must not be understood to say that the use of alcoholic drinks during cholera epidemics is necessarily injurious. On the contrary, I believe that such use of them as sober and Christian men may make is rather a preservative against the infection, as well by enabling the stomach to digest food more perfectly, as by promoting a degree of cheerfulness which is by no means the least efficient of the preservatives against the disease. A hopeful and happy disposition is generally thought to be as strong a shield against cholera as despondency and affright are believed to be an invitation to its attacks. It has been said in opposition to this view that the disease has been peculiarly fatal to the inmates of insane hospitals, who are supposed less liable than other persons to panic. But the objection is not valid. Of the insane, a large proportion are monomaniacs, and have at least as lively a sense of danger from an epidemic as other persons. Besides, the feeble bodily health, and the mental despondency of many more, render them peculiarly easy victims to all depressing diseases, and therefore in the last degree to the exhausting attacks of cholera, and indeed of all epidemics.

The quality of the *food* exerts a decided power in determining the attack. The coarse or scanty diet of the poor is no doubt to be added to the other causes already pointed out which operate unfavorably upon this class of society. It has also been observed that that form of diet which occasions attacks of sporadic cholera is most apt to favor the development of the malignant form,—to wit, exclusively vegetable food, particularly in its fresh or uncooked state, unripe fruits of all kinds, everything which is itself acid or tends to become so in the stomach, indigestible substances, such as pork, pickles, and salt provisions generally. The influence of a too exclusively vegetable diet in augmenting the mortality of cholera is perhaps shown by the enormous number of deaths which have occurred among the natives of Hindostan as compared with those among the European population in the same country. But too much importance is not to be attached to this circumstance; for in Ireland, where the use of a vegetable diet is so general, I cannot learn that the mortality from cholera has been unusually great.

The propagation of cholera is, however, due essentially to but one cause: CONTAGION. It must be understood that contagion may be *direct*, as where disease is transmitted immediately from one person to another; or *indirect*, as where the clothing of the sick, their fæcal and other discharges become the media through which the contagious germs are conveyed. Moreover, this indirect contagion may take place through the air that is breathed, or through the water that is swallowed, and therefore through channels which may be quite unsuspected of carrying it.

The question we have to solve is this:—Does cholera, outside of the locality in Hindostan where it originally prevails, give rise to other cases of the disease? If examples of this sort can be produced in any considerable number and perfectly authenticated, the question is decided. One that occurred under my own observation is the following: Years ago a severe and fatal epidemic of cholera broke out in the Philadelphia Almshouse. The resident physicians were abundantly occupied in the ordinary care of the sick, and five or six young gentlemen were invited to take charge of the cholera patients. These patients were removed from the several parts of the house where they were originally attacked, to a building in the centre of the quadrangle, and were there attended by the physicians from the city who had volunteered their aid. Three or four of these physicians were attacked by cholera, and one of them died. At this time there was no cholera at all in the city, and the young gentlemen had, therefore, no predisposition to the disease. They were attacked while rendering their services to the sick; while the other, or resident, physicians of the house, did not suffer. Now, the only difference between the position of the two sets of physicians was that the one was in constant communication and contact with the cholera patients, and the other was very rarely so. I think, then, the inference is inevitable that the disease was, in this case, communicated from the sick to the well.

Dr. Alison, the eminent professor of Edinburgh, has published still more unequivocal instances, in which persons having left a place where the cholera prevailed for one in which no case of it had occurred, were there seized with the disease, and those in immediate attendance on them were also attacked. Yet the cholera did not extend in these places, and in fact no other cases occurred there at all during the rest of the epidemic. Similar examples have been related of the propagation of the disease in this country.

Other facts demonstrating the contagiousness of cholera may be cited like that at the Philadelphia Almshouse, and even stronger than it. *E.g.*, in 1832 the cases of cholera in Edinburgh were in the proportion of *one* to every *twelve hundred* of the population of the city; while among those in attendance *on the sick* the proportion was as *one in five*. In 1848–9, *one-fourth* of the nurses employed in the cholera hospital took the disease, while in the general hospital, "only a few paces distant," where no cholera patients were received, not a single attendant was attacked.

It has been again and again observed that persons employed to wash the body- and bed-linen of cholera patients have suffered in a much larger proportion than other persons of the same social condition engaged in different occupations. The introduction of the disease by a single ship among a previously healthy population is a fact which has been repeatedly observed. Thus it was that cholera entered Constantinople in 1865. A ship having cholera on board reached that port the first week in July, 1865; thence the disease passed into the hospital, where thirty fatal cases soon occurred; and from the hospital it passed into the city, where it soon became epidemic.

But the disease is communicated by contagion, less evidently indeed, but none the less certainly, whenever the discharges from cholera patients contaminate water which is used by healthy persons for drinking. This has happened again and again. In London there was a certain well into which the contents of a sewer had been percolating for months. Of the water of this well hundreds of persons had been drinking without any obvious injury. At last a case of cholera occurred near by; the dejections were thrown into a privy which communicated with the sewer and indirectly with the well, whereupon more than five hundred persons who received water from that particular well were attacked within three days.

Again, at Constantinople, in 1865, the clothes, mattresses, etc., of cholera patients were washed at a fountain, the basin of which was divided into two parts by a parapet wall; one part was used for washing clothes, and the other for drinking-purposes. Unfortunately, the waste-pipe being broken, the foul water of one side communicated with the clean water of the other, and in one day sixty people died in the small portion of the city which was supplied by the infected stream.

These facts, and countless similar ones, confirm the belief which is suggested by the symptoms of epidemic cholera, their essential identity with those of the sporadic form, and the condition of the alimentary canal after death,—that the material cause of the disease is a poison received into the body by the mouth and stomach, and that the only demonstrable agent in the dissemination of the disease consists of a specific poison contained in the alvine evacuations. It seems difficult to admit that the poison is *atmospheric,—i.e.*, inherent in the atmosphere, and not merely absorbed into it from the sick and their excretions; for we are acquainted with no facts whatever which prove the disease to have originated independently of previous cholera patients, or their dejections conveyed by clothing, water, air, or other possible vehicle. Nor has the atmosphere revealed any constituents, or conditions, during cholera epidemics, different from those of the healthiest seasons.

On the contrary, the whole history of cholera shows that it advances from point to point, wherever the *men or things* infected with it are carried; by gradual and short steps on land, as by caravans, or armies, or individual travellers, but with vast strides across seas and oceans, when it is conveyed in ships. Highways and railroads and river-courses mark out its path across continents, because in these the throngs of men are thickest, and continue, like the links of a chain, the long procession of cholera victims which had its beginning in the jungles of Hindostan. Seaports are its favorite halting-places; because in them infected ships and crews congregate. Great cities furnish its most numerous victims; because in them are the very hotbeds in which tens of thousands of human beings are perpetually kept upon the narrow verge which separates disease from health, and where the water, the air, the food, may all readily become contaminated by the germs of the pestilence and spread it through a thousand channels.

This dissemination from man to man, directly or indirectly, is sufficient to account for the spread of cholera; and it is unnecessary to invoke besides, as some persons do, an undemonstrated and occult condition of the atmosphere which predisposes men strongly to be affected by the emanations from the sick, their excretions and clothing.

We may conclude that cholera is contagious, and that its contagious element is disseminated by whatever can carry a material poison: by bodies of men and by individuals; by ships and by clothing; by winds and by water, by dust and by food; and that the germs of the contagion are contained in the alvine evacuations and in nothing else. The probable nature of those germs we shall have occasion to speak of again.

SYMPTOMS.—The symptoms of cholera are usually divided into three stages: 1. the *forming* stage; 2, the *cold* stage; and 3. the stage of *reaction*. Such a division is natural and proper, because the disease may terminate in any one of these periods: in the first, by an arrest of the attack; in the second, usually by the death of the patient; in the third, by his convalescence.

THE FORMING STAGE, or stage of *invasion*, may be marked in some cases by a *sudden*, and in others by a *gradual*, development of symptoms. In the former the patient is seized with a general depression of all the faculties of mind and body. The senses are irritable, the head aches and is confused, there is a disinclination to sleep, the limbs totter under the weight of the body, the pulse is frequent and feeble, occasionally fainting takes place, and the skin is cool, and moistened with perspiration. When the attack is more gradual, the earliest symptoms are usually abdominal. Wandering pains are felt in that region; it is distended with flatus, and emits rumbling noises; there is more or less nausea, and a discharge of thin, yellowish, and offensive stools, which gradually grow lighter in color and more frequent. At the same time, the general debility and prostration are remarkably great, and sometimes slight cramps are felt in the limbs. This condition is of variable duration. Sometimes it precedes the full development of the attack by a few hours only; in other cases it lasts for a week or ten days before the graver phase of the disease appears. It is during this stage that the treatment of cholera is most successful: indeed, *it is the only stage in which we can rely upon the effects of remedies.*

The succession of the early symptoms, and the duration of the first stage, are generally such as I have described. But cases now and then occur in which the whole of these phenomena follow one another within the brief space of one or two hours. The patient is stricken down with sudden feebleness, is seized with profuse vomiting and purging and general spasms, and dies without any interruption of the symptoms or any tendency to reaction.

But, more generally, after a greater or less duration of the first stage, the SECOND OR COLD STAGE is ushered in by a marked aggravation of all the symptoms. The discharges of fluids from the stomach and bowels grow incessant and more abundant, and vary from ten or twelve to twenty or even more in the twenty-four hours. They are usually passed without effort, and consist of a large quantity of serous liquid, at first somewhat tinged yellow with bile or fæces, but afterwards whitish or grayish, like rice-water, and containing flakes of coagulated fibrin or the *débris* of the intestinal epithelium. In a few instances the stools are tinged with blood.

Vomiting usually coincides with the copious purging. After the food which the stomach may happen to contain is thrown up, large quantities of a whitish or milky-white fluid, exactly like what is discharged from the bowels, are evacuated; more frequently, however, this fluid is at first tinged with bile. It is poured forth, less by the ordinary act of vomiting than by gushes, as if it overflowed from the throat and mouth; and it often escapes from the stomach and bowels at the same instant. Sometimes a distressing hiccup accompanies these symptoms. It is, indeed, but one of the spasms which affect the whole muscular system. They usually commence in the fingers and toes, seize upon the muscles of the calf of the leg, and render the muscular wall of the abdomen as hard as a board. The pain which they produce is extremely severe. At this period the debility is extreme; the patient is unable to rise, or even to move at all, except under the stimulus of the spasmodic pain. The features are shrunken; the nose is sharp and pale and bent to one side. The dusky and sunken eyes, the thin lips, the hollow cheeks, and contracted muscles that stand out like cords under the tight and clammy skin, present a physiognomy such as belongs to no other disease. The hands and feet grow cold, and steadily the coldness creeps upward towards the trunk; the integuments of these parts are shrivelled and damp, as if they had been long macerated in water; and, if they are pinched up, the fold of the skin remains for some time. The eyes grow dull and dry, the tongue has a pasty or sticky feel, the urine is almost suppressed. As the attack advances, the patients fall into a dull, listless, and motionless state, which must not be mistaken for insensibility, but which arises from complete muscular exhaustion and a want of energy in the cerebral and spinal functions. They express no interest in anything, and hardly notice the attentions or the distress of their friends. Yet they will generally give clear though languid answers to questions, and fall again into their inert and unobservant state.

As these symptoms advance, as the fluids of the body are wasted away, the blood accumulates and stagnates in the veins, and gives to the hands and feet, the nose and lips and other features, to the neck, and even to the entire surface of the body, a bluish, leaden, or violet tinge, precisely like that of cyanotic children. The pulse, which was already weak and thready, ceases to be perceptible; the carotids, even, can no longer be felt; then the impulse of the heart ceases, and its first sound becomes inaudible. The skin is everywhere cold, is sometimes of an icy coldness, and yet the patients seldom complain that it is so. Even the breath as it issues from the nostrils is cold.

The blood no longer circulates, and the heart is still. If a vein is opened, a few drops of black and viscid fluid trickle from the wound, and, if they coagulate, yield but little serum, and, in place of a clot, nothing but a diffluent jelly. The voice falls to a mere whisper, or is quite extinct. The features assume a horrid aspect: the temples and the cheeks are hollowed; the nose is pointed, and the nostrils are obstructed with dry powdery crusts; the eyes are dry, dull, and sunken behind the half-closed and purple lids; the conjunctiva is no longer moistened by its secretion, and grows bloodshot; the temperature of the mouth may fall to 79° or 80°; a viscid exhalation bedews the icy and marbled skin; and the whole body is so shrunken from its natural proportions as to lose all marks by which its identity may be usually recognized. From this pulseless, cyanotic, cold, and exhausted condition there can be but one step to death. It generally comes on gradually, the patient sinking into complete insensibility; in other cases he expires suddenly upon making some unusual effort.

REACTION.—At any period of the progress which has been described, the contest between the system and the disease may be decided in favor of the former. If this takes place in the early stage, before there is any blueness of the skin or any very profuse evacuations, the recovery may be gradual and without remarkable phenomena. The pulse regains, more or less, its natural force; the skin grows warm again, first upon the trunk and afterwards upon the extremities; the breathing becomes easy, and, the diarrhœa having already ceased, convalescence is established. But in proportion to the violence of the symptoms, the intensity and duration of the cold stage, the cramps, and the evacuations, will be the tendency to an opposite extreme upon recovery, a tendency to febrile reaction, accompanied with more or less congestion of internal organs. The first sign of improvement is the subsidence of the evacuations, of the vomiting, and then of the purging, or, if the diarrhœa continues, it loses the characteristic appearances of cholera, and is more or less brown; the next step is the diminished coldness of the extremities; then the improvement of the pulse; and finally the restoration of the strength. Or, if the attack has been severe, particularly if the algid stage has been prolonged, fever of a low form is set up, which, indeed, may ultimately terminate in death. It is marked by dryness of the tongue, a brown crust upon the teeth and gums, jerking of the tendons, delirium, and coma; in one word, it is a typhoid state. Sometimes these symptoms are evidences only of exhaustion and of the inability of the system to resume its normal action; in other cases they appear to be due to a local inflammation of low grade established generally in the lungs, and which is usually latent. In other cases, again, the nervous system bears the brunt of the reactionary effort, and the patient is attacked by convulsions or perishes in an apoplectic fit. These phenomena appear to be due in most instances, if not in all, to renal obstruction, by which the effete matters of the system which should be excreted by the kidneys are retained in the blood, and the phenomena, as a whole, may be termed uræmic. In other cases a wasting diarrhœa, due probably to the damaged state of the intestinal mucous membrane, is superadded to the already existing typhoid state. Occasionally the parotid glands become enlarged and painful, and sometimes a measly or roseolous eruption appears upon the skin.

It frequently happens that convalescence is slow and irregular. The system seems shattered by the trial it has passed through; the nervous susceptibility remains morbid for a long time, or, what is still more usual, the function of digestion is greatly impaired. The appetite is capricious and the digestion feeble. The mouth is pasty, the abdomen tympanitic, the bowels are irregular and alternately confined and relaxed. Finally, patients who leave their bed too soon, or indulge prematurely in their ordinary diet, are liable to relapse, perhaps fatally, into the original disease. In fact, it has occasionally happened that such a relapse has taken place several days after an apparent restoration to perfect health.

ANATOMICAL CHARACTERS.—In cholera, as in most other diseases, the pathological condition of the organs does little more than explain the *effects* of the disease properly so called: it reveals the mechanism by which the secret and inscrutable essence of the disease produces its ultimate effects, but it throws very little light upon the nature of that essence or efficient cause. But at the same time it leads to a probable conjecture of the primary element in the derangement of the organism, and explains in part, at least, the mode in which remedies which have been found successful in the treatment exert their salutary powers. I shall not attempt to present a detailed and minute account of this chapter in pathological anatomy, but shall draw attention only to its more important divisions.

And, first, of the *blood*. The grosser physical characters of cholera blood, as found after death, are these: As a general rule, the arteries are nearly empty; they sometimes, however, contain a small quantity of black and viscid blood. The veins and the right side of the heart are filled with dark blood, which is in general very imperfectly coagulated, and often fluid; even when clots are formed they are for the most part soft, and resemble blackberry jelly. The veins of the brain are usually gorged with liquid and black blood, and the same is true of the veins of the small intestines. The red globules themselves undergo important changes. They have lost their watery constituents and become shrivelled and irregular in shape, and may even be completely disintegrated. Such is the usual state of the circulating fluid; but some observers have found firm clots within the heart, more or less deprived of coloring-matter, forming true fibrinous coagula. Still, this condition is undoubtedly of infrequent occurrence.

Similar changes are found in the blood drawn during life. Owing to the loss of water, the proportion of its solid ingredients is relatively increased, so that a given bulk of it weighs more than an equal quantity of healthy blood. In other words, its specific gravity is increased. Thus, the maximum specific gravity of healthy blood is 1060, while that of cholera blood is 1080. The serum of the blood becomes denser than natural, and rises from 1028 to 1040. In like manner, when we come to examine the solid constituents of this fluid we find the proportion of them all increased. The proportion of red globules rises from 140 to 170 parts in 1000. The fibrin, although its relative quantity does not increase, appears to have undergone important changes, for it coagulates with difficulty or not at all. The albumen, of which the normal proportion is 70, generally falls, and has been found as low as 49 (Becquerel and Rodier), a portion of it having been lost by percolation through the intestinal mucous membrane and by secretion through the kidneys. On the other hand, the fatty and extractive matters, like the globules and fibrin, are augmented, and in even a larger proportion. For normally they average ten parts in a thousand of the blood; but in cholera they rise to twenty, thirty, and almost to forty parts in a thousand. This remarkable circumstance has been attributed to the absorption of the adipose tissue, which is so general and so rapid in this affection. We shall presently see that this fatty matter is poured out through the intestinal tube. In connection with the state of the blood, a singular fact relating to the *temperature* of the body before and after death may here be noticed. In the algid stage all the external portions of the body are unnaturally cold, while the interior, as indicated by the temperature of the vagina and rectum, is above the normal grade; precisely as happens during the cold stage of the algid form of malarial fevers. In those patients who die during the collapse, and very cold, as was before remarked, the temperature of the surface rises one, two, or three degrees in the course of an hour or two; and the body is much longer in cooling than usual. Sometimes, indeed, the friends of the patient are led to hope that life is not altogether extinct. Another circumstance is apt to encourage this hope, or to inspire the ignorant with a mysterious horror. It is the *muscular contractions* observed in various parts of the body. They "vary in extent from flickering and tremulous undulations in a few fibres, scarcely to be seen or felt, to contractions sufficiently powerful to move the limbs from their position or even to displace the body itself." They begin shortly before death, and last a variable time, from a few minutes to two hours. Similar phenomena have been observed in other diseases, and especially in yellow fever.

On opening the *abdominal cavity*, one is struck by the general pink or rose tint of the peritoneal coat of the intestines. It is produced by a hyperæmia of the portal venous system; sometimes the color is very dark, the venous trunks being full of pitchy blood. The serous surface is drier than usual, and often has a sticky feel, from a layer of tenacious glutinous matter, which forms a lather when rubbed between the fingers. This shows it to be albuminous.

The dryness of the peritoneum is a type of the condition of all the tissues, of the meninges, the pleura, the pericardium, the brain, the lungs, the muscles, and the glands.

The *contents* of the intestinal canal vary somewhat in its different portions. In the *stomach* the liquid is generally thin, transparent, greenish or grayish, and occasionally has a tinge of deep red. It sometimes contains portions of coagulated mucus, resembling shreds of boiled rice, and also an unctuous substance which adheres to the walls of the organ and is thought to be modified albumen. Fatty globules have been observed floating in the gastric liquid, as they have also been in the stools and in the urine during life, as well as in the vomit of cholera.

The same serous fluid is found in the *small intestine*, but its color becomes a deeper red, almost of a chocolate shade, in the ileum. At the upper part of the bowel it is thicker than below; indeed, it seems at every step to be diluted by a fresh secretion of liquid from the mucous membrane. The epithelial shreds and patches are more abundant here than in the stomach, and along with them is also found the albuminous matter already described, deposited in a thin layer upon the surface of the bowel. In the *large intestine* the contents do not differ materially from those last described. In some cases the intestinal liquids, "when exposed to a temperature of 212° F., coagulate like the serum of the blood, and yield a similar odor, thus exhibiting the presence of a large amount of albumen." Some observers have failed to observe this effect,—partly, it may be suspected, because they neglected the necessary precaution of rendering the fluid, which is generally alkaline, acid before exposing it to heat; for unless this be done no coagulation will take place. The albumen, too, is often altered in its physical characters, and requires to be boiled with nitric acid before coagulating. The brown or chocolate color of the liquid in the small intestine which is sometimes observed, and which I have already referred to, is due to the presence of the coloring-matter of the blood derived from broken-down, and occasionally to the presence of unaltered, red corpuscles.

The *mucous membrane of the stomach* seldom presents any organic changes. Its tissue is swollen by the infiltration of serum. Its color is usually unnatural; sometimes pale, but more frequently of a rosy or of a purplish red, like certain onion-skins, or else of a dark brownish-red color, which is due to the congestion of the veins in the sub-mucous cellular tissue. When the color is light, hyperæmia is its principal cause; but when it is dark, congestion of the larger trunks and ecchymosis exist. Occasionally this membrane is reduced to the condition of a mere pulp. The same varieties of color are found in the *small intestine*, increasing gradually in depth from the duodenum to the cœcum, being most marked in the lower portion of the ileum, in consequence of the sub-mucous extravasation of blood at this point. Here, as in the stomach, the diffused and brighter redness is found to be due to extreme capillary congestion. But much more important changes are revealed by a microscopic examination. As long ago as the first American epidemic of cholera (1832–35), Prof. Horner, of the University of Pennsylvania, described an exfoliation of the epithelial lining of the alimentary canal, whereby the extremities of the venous system are denuded, as characteristic of cholera alone. And in 1849 Prof. Jackson, Emeritus Professor of the Institutes of Medicine in the University, and Dr. John Neill, then Demonstrator of Anatomy in that institution, in conjunction with the late Dr. William Pepper, and with the late Dr. Goddard, who was also at one time Demonstrator of Anatomy in the University, presented a report to the College of Physicians, in which they, too, showed that "the epithelial layer of the intestinal mucous membrane was either entirely removed, or was detached, adhering loosely." I claim for the University the credit of having made this discovery, whatever may be its value, long before it was announced in Europe. Indeed, it was only in 1860 that the eminent pathologist and microscopist Dr. Beale, of London, arrived at the same conclusion. He says of the rice-water contents of the intestines, "This has been proved to consist almost entirely of columnar epithelium; and in very many cases large flakes can be found, consisting of uninjured epithelial sheaths of the villi. . . . In bad cases it is probable that almost every villus, from the pylorus to the ileo-cœcal valve, has been stripped of its coating during life." The capillary veins being also greatly distended, it is evident that there is no barrier to the transudation of the fluid portion of the blood into the intestine;

while an almost insuperable one exists to any absorption from the bowel. The solitary glands are almost always distinct, their prominence and general increase of size being, for the most part, due to the œdematous state of the tissue in which they are contained, but partly also to the presence of a substance which appears to be albumen. The patches of Peyer do not undergo any real alteration, but, like the solitary glands, are swollen by an imbibition of serum. The mesenteric glands are slightly enlarged, and to some extent infiltrated with "a whitish, granular exudation" (Virchow), of undetermined nature, but probably albuminous.

In the *large intestine* are found the same changes of color and consistence of the mucous and submucous membrane as at the upper portion of the intestinal canal, but with much less frequency. The isolated follicles of this, as well as of the upper division of the bowel, are generally prominent, and sometimes extremely numerous.

Neither the *spleen* nor the *liver* presents any special alteration. The *gall-bladder* is generally distended with glairy bile. The *kidneys* are often congested, and the calices contain a large quantity of epithelial scales, which give the urine a turbid appearance in the bladder. The urine is albuminous, as it is found to be in the early stage of the disease. The *lungs* present no other lesions than result from hypostatic congestion; and the *pleuræ*, like the peritoneum, have sometimes a sticky feel. The *heart* offers no uniform alteration. The *brain*, too, is unchanged; but the pia mater is infiltrated with serum, which is also abundant in the lateral ventricles; and the cerebral veins are gorged with black blood.

Such is a succinct account of the most important pathological changes in the organism which are produced by cholera. And, now, do they throw any light upon the mechanism of the disease? That its primary cause is material, and acts upon the gastro-intestinal mucous membrane and upon the organic nervous system, we cannot doubt. The whole history of its epidemic progress proves this to be the case, as well as the lesions found after death. Unlike other epidemic diseases, such as typhus, yellow fever, the plague, etc., we can find no primary alteration of the blood in it, which will throw light upon the succession of the symptoms. These, on the contrary, point to the gastro-intestinal canal as the material starting-point of the morbid processes which develop the phenomena of cholera. All of the phenomena of the complete attack point in the same direction. Most of them succeed upon a profuse flow of the serous and watery portions of this fluid into the bowels. This it is that produces the vomiting and purging; this prostrates the patient, and wastes away, in a few hours, the fullest and firmest form; this chills the extremities and afterwards the trunk; this thickens the blood, so that the capillary vessels refuse any longer to convey it, and spreads its cyanotic shadow over the whole surface of the body; this cuts off the supply of blood from the heart; this paralyzes the nervous system, organic as well as animal; this obstructs the kidneys and arrests their secretion; and this, therefore, acting through the various links of the pathological chain, *is the cause of death.*

But what is the remoter cause of cholera? What sets in motion these successive wheels which end in crushing out the life of the cholera victim? Evidently, something received from without and swallowed. One opinion is that it consists of certain microscopic fungi, or their germs, which, on being received into the bowels, propagate their kind and destroy the epithelium. It is believed by some that this fungus takes its origin on the banks of the Ganges, and that it is produced upon the rice-plant. Having once originated the disease, its germs contained in cholera dejections, being mixed with water or borne upon the wind, enter the system of new victims, who, in their turn, disseminate the plague. Another theory is (Richardson) that, "as pus undergoes changes which convert it into a septic poison, so the excreted matter from the alimentary canal is equally capable, under peculiar conditions of oxidation, of producing an alkaloidal organic poison, which, soluble in water, but admitting of deposit on desiccation," becomes the agent for the dissemination of the disease. The former is the more generally accepted opinion, and seems to be supported by many facts; but the latter has numerous supporters and many facts also in its favor. Opposed to the latter theory, however, stands the insuperable objection that outside of Hindostan epidemic cholera never did and never does arise spontaneously, but can always be traced to its source in that country. Consequently, there must be in the disease a certain specific something,—whether a cryptogam or not is of subordinate importance,—an essential material, capable of propagating itself in the alimentary canal of human beings, of exciting there certain definite lesions and symptoms, and of communicating to the alvine discharges the property of occasioning the disease anew.

In what does sporadic cholera differ from malignant epidemic cholera? Only in its cause and its degree. Its mechanism is the same. Yet sporadic cholera is a disease of the stomach and bowels usually produced by the direct application of irritants to their surface. This no one doubts. Wherefore it seems but rational to conclude that epidemic cholera is also an intestinal disease, which differs from the sporadic form chiefly by the intensity of its cause, the gravity of its symptoms, and the nature of the special cause which produces it.

DIAGNOSIS.—The only diseases which malignant cholera resembles are the sporadic form of cholera, serous diarrhœa, and poisoning by certain irritant substances. I have already intimated the difficulty of making a distinction between sporadic and epidemic cholera, founded upon the symptoms alone. In both there may be vomiting and purging, coldness of the limbs, cramps in the legs, feebleness of the pulse, abdominal pain, and faintness. In the epidemic disease the additional symptoms seem to depend upon the profuse loss of fluids from the bowels. In the sporadic form the discharges are mucous and bilious for the most part, and take place first from the stomach and afterwards from the bowels; in the epidemic they are serous, or at least watery, stools, and for the most part exist for some time before vomiting sets in; when they become profuse the skin assumes a bluish color. The serous instead of bilious discharges, and the cyanotic color of the skin, are, then, the diagnostic marks of cholera asphyxia. But, as the cyanosis does not appear until the advanced stage, the only remaining symptom, and the only *symptom* at all, which distinguishes epidemic from sporadic cholera *during the first stage,* is the *watery evacuations* of the former disease.

Serous diarrhœa, or *diarrhœa aquosa* of some authors, resembles cholera in a certain degree: that is to say, watery discharges accompany both affections. These form the characteristic symptom of serous diarrhœa; and when they are accompanied with vomiting, as sometimes happens, there is nothing in the symptoms of the attack to distinguish it from a mild one of epidemic cholera. I do not know that this form of diarrhœa has ever become epidemic.

Malignant cholera also bears a strong resemblance to acute poisoning by arsenic. "The vertigo, derangements of the senses, the great depression, epigastric distress, thirst, cramps, the general coldness, and suppression of the urine,—all of these symptoms are common to both morbid conditions.'' But *burning heat and constriction of the œsophagus*, and *violent pain* in the *abdomen*, are occasioned by arsenical poisoning, and not by cholera; and this form of poisoning never produces such stools as distinguish cholera.

TREATMENT.—In estimating the value of the treatment of cholera, a very important consideration presents itself on the threshold of the inquiry. Is the treatment of the premonitary diarrhœa to be considered as forming a part of the treatment of cholera? No doubt an affirmative answer to this question should be given. I have already pointed out the fact that in a great majority of cases diarrhœa constitutes the first and forming stage of the graver affection, and constitutes also the first evidence of the action of the cholera poison. The prevalence of diarrhœa during cholera epidemics, whether or not the season or the other circumstances be such as usually occasion diarrhœa, shows that in each case the bowel complaint proceeds from the same cause. In the English epidemic of 1849, when the mortality from cholera was 53,241, that from ''diarrhœa'' was 18,869. The enormous number destroyed by the latter disease clearly indicates that the cholera poison produced diarrhœa where it did not occasion the more malignant disease. The treatment, then, of the stage of diarrhœa is in reality the treatment of cholera. I may add, what is of vastly more value than this pathological conclusion, it is *the only stage of the disease in which treatment makes a sensible impression upon the mortality*.

When the disease comes on gradually, in the form of diarrhœa, it can nearly always be arrested by the usual remedies for bowel complaint. These may consist of opium either with stimulants or with astringents. The stimulants most generally used are the essential oils of cajeput, cloves, cinnamon, peppermint, etc., with which chloroform, ether, or Hoffmann's anodyne may be associated. Probably such agents are particularly indicated when the attack has been somewhat sudden. The same may be said of hot drinks which are given at the same time, and which should contain some alcoholic distilled liquor in moderation. The patient meanwhile should be kept warm, and if necessary wrapped in blankets, and an effort made to force and maintain a free perspiration. If such remedies do not speedily diminish the diarrhœa, they should be discontinued. Owing to the depressing influence of the epidemic poison, these means will be of little value unless the patient be kept perfectly at rest. He should lie in bed, and not rise at all,—not even, if possible, to obey a call of nature. As a general rule, astringents are more efficacious than stimulants in checking the premonitory diarrhœa. Chalk mixture, with tincture of catechu and a little laudanum, is sufficient if the symptoms are very mild, and particularly if the stools continue to be brownish. But if they assume the serous character, it is better to resort to acetate of lead and opium. By many it is preferred to combine *calomel* with these substances, in the pilular form. The proportion of opium should *never be* large, and least of all on the approach of the fully-developed stage of cholera; for then it tends to depress and paralyze, instead of stimulating, the functions. At the appropriate period, pills containing one grain of acetate of lead and a quarter grain of opium may be administered every hour.

In the second stage of cholera, with serous vomiting and purging, the treatment becomes more difficult; for the action of medicines must be very slight when they remain but a short time in the stomach and are copiously diluted by its secretions. In reviewing the long catalogue of those which have been prescribed during this stage, I can scarcely find one which is even claimed to have been effectual. Bleeding has nothing but the fanciful notions of enthusiastic gentlemen to recommend it. Alcoholic stimulants, ammonia, narcotics, astringents, quinia, emetics, even, and purgatives, have had their advocates; but no successful results attest their value. On the contrary, no well-informed practitioner would now place the least dependence upon them.

Alkaline solutions,—muriate of soda and sesquicarbonate of soda,—warm, and largely diluted, have been injected into the *bowel*, with the effect of replenishing the exhausted vessels and restoring, for a time, warmth to the skin, force to the pulse, and animation to the countenance; while they relieved the cramps and dispelled the cyanotic color of the skin. Similar solutions have been injected into the *veins*, with still more striking and encouraging effects. But these phenomena were like those produced by galvanizing a corpse: a sudden and almost miraculous development of energy displayed the semblance of reviving life; but hardly had hope been conceived before it was doomed to be disappointed. The symptoms returned; and usually no second resurrection followed the persistent employment of the remedy.

A plan for the success of which a persistent claim has been set up by many respectable practitioners is the one which was proposed by Dr. Ayre, of Hull. It consists in giving one or two grains of calomel every five or ten minutes, and one or two drops of laudanum with the first few doses of the drug, and in perseveringly continuing the same dose, at the same intervals of time, until the symptoms of collapse become materially subdued. From that time it is not claimed to do good, and may, certainly, be injurious.

Of other internal remedies, those of a stimulating class, and particularly brandy and wine, would seem to be suggested by the general prostration and exhaustion and the coldness of the skin. They have, accordingly, been used very extensively; and the general result of experience is that they are *worse than useless*. They not only do not tend to arrest the discharges and the progressive coldness, but, on the contrary, they augment the vomiting and distress.

Everything, besides what has been mentioned, that appears to be of any service, is beneficial only by moderating some of the more troublesome symptoms of the attack. Ice is generally grateful to patients in impending or actual collapse. It relieves the burning thirst, and, in many cases, seems to favor reaction, while it appeases the feeling of intense heat in the abdomen. Iced water may, in like manner, be given repeatedly, but not in such large quantities as, by their bulk, to excite vomiting. Cold carbonated water is very grateful to many patients. Lime-water, with milk, may also be tried, as a means of affording nourishment and controlling, in some degree, the vomiting.

A very eminent physician and medical writer of London insists that cholera patients should have none but hot drinks, because their bodies are already so cold. Fortunately, nature's voice is more authoritative; and cholera patients clamor for cold drinks and swallow them greedily, in spite of the theoretical conclusion that they ought to prefer hot ones.

A great variety of external applications have been resorted to for the purpose of retaining the blood in the cutaneous vessels, of maintaining the warmth, relieving the spasms, allaying the vomiting and purging, etc. Of these, the most commonly employed belong to the class of rubefacients. Sinapisms are applied to the epigastrium, or to the whole abdomen. Frictions of the extremities with liniments containing turpentine, ammonia, cantharides, or tincture of capsicum, or simply with dry and coarse cloths, and even ligature of the thighs, are commonly resorted to. But I doubt much whether any means which agitate, disturb, and exhaust the patient are likely to be useful. The revulsive action of mustard, however, is not liable to the same objection, and should certainly not be neglected; and ligatures around the thighs may also be tried. It is a curious and interesting fact that *heat* applied to the skin, so far from alleviating the symptoms and restoring the circulation to the surface, is almost always ineffectual, except in relieving the spasms in a few cases. This is strikingly true of *warm baths*, either of water or of vapor. Their depressing effects are sometimes marked and unmistakable, and are much complained of by the patients. At the outset of the disease they seem to be more efficient.

On the other hand, *cold water*, in the form of douche or affusion, is of decided efficacy in some cases, and much more grateful than warm applications. The patient is directed to be laid upon the floor, while cold water is dashed over him; or to be seated in a tub, while the water is poured rapidly over his body. Immediately he is to be dried, and wrapped in blankets, and after an hour or two the operation may be renewed. Frictions of the skin with *ice* have also been productive of advantage. Still, it must be confessed that the results of the treatment by cold water do not authorize its *general* adoption.

If, under the use of any of the means which have been enumerated, it is found that reaction commences, it becomes necessary to temper the activity of the stimulant remedies, but not to desist entirely from their use. To do so prematurely would be to expose the patient to relapsing into the cold stage. But they must be more moderately used. For if this were not done, we might have to regret producing a violent reaction hardly less dangerous than the original attack.

When this does occur under a decidedly sthenic form, it may be necessary to employ moderate depletion by cups or leeches to the back of the neck, in order to calm the cerebral excitement or relieve the stupor. For the same purpose, and where depletion is judged to be improper, cold lotions and ice may be applied to the head. Blisters to the epigastrium may be directed, to calm the vomiting, if it should continue, or to relieve pain in the stomach. If the urine is not duly secreted, mild diluent and mucilaginous drinks are useful. Some persons recommend, also, the weaker salines; but the risk of renewing the diarrhœa should make us cautious in their use. Care should be taken to prevent distention of the bladder, either by applying warm fomentations to the hypogastric region, or by introducing the catheter. The management of the *convalescence* from cholera requires attention. The most important precepts relate to the *diet* and *exercise.* Premature and undue exertion is most sedulously to be avoided, as well as all exposure to cold, and all attention to business that involves anxiety and fatigue. The diet should be mild, digestible, and nutritious, and not too abundant. If, as is usually the case, the stomach digests feebly, it must be aided by the stimulant operation of cayenne pepper or a little mustard used with the food, and by bitter vegetable infusions, or a little quinia, taken before the principal meals. If diarrhœa recurs, the food must for the time be rendered less stimulant, and a few doses of chalk mixture or of bismuth, with catechu or with a little opium, may be prescribed. When, on the other hand, constipation follows the attack, it may be removed by allowing sound and ripe fruit in its fresh state, or, what is safer, stewed fruit; or else a small dose of castor oil or of rhubarb may be directed.

Such are the causes, characters, and treatment of cholera. I have endeavored to impress upon you, as the capital point in the discussion, the extreme importance of meeting the disease at the very threshold, whenever it does not assault violently and suddenly. There you are its master, and may safely and easily drive it away. But once it has passed that boundary and taken possession, you will have a sharp struggle with it for the victory, and too often will be compelled to leave it master of the field.

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